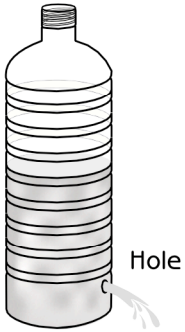
Leaky water bottle

Before drop/toss

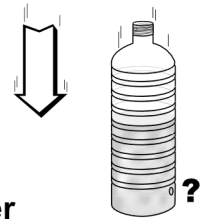
Clear plastic bottle, small hole at bottom, filled with water, and no cap.



1. Why does the water flow out the hole before the bottle is dropped or tossed?

2. When the water bottle is *dropped* the flow of water:

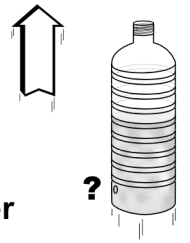
a) becomes faster
b) stays the same
c) becomes slower
d) stops



Explain why the flow of water behaves this way.

3. When the water bottle is *tossed upward* the flow of water:

a) becomes faster
b) stays the same
c) becomes slower
d) stops



Explain why the flow of water behaves this way.

4. What is meant by 'free-fall'?

5. What do freely falling objects experience?

Leaky water bottle - explanation

▪**Why does the water flow out of the hole before the bottle is dropped or tossed?**

A hand exerts a force on the bottle to stop it from falling. The rigid bottle then exerts a force on the water to stop it from falling. Being a liquid, the water squirts through the hole due to the gravity force pulling it downward.

▪**When the water bottle is dropped, the flow of water:** **(**d) stops

▪**Explain why the flow of water behaves this way.**

The water is falling due to gravity so it doesn't need to 'sneak' out the hole to fall. The bottle is falling with the water and doesn't exert a force on the water.

▪**What is meant by "free-fall"?**

An object is in free fall when it is accelerating at the rate of gravitational acceleration and without any external retarding or accelerating forces.

▪**When the bottle is tossed upward, the flow of water:** **(**d) stops

(The toss should be smooth so as to not spin or tumble the bottle.)

▪**Explain why the flow of water behaves this way.**

Again, once the bottle and water are free from the hand, they are in free-fall. In this case, there is an initial velocity upwards, but both the bottle and water are falling toward the Earth. (For the short time that the hand accelerates the bottle and water upward, the water flowing out *does* increase, but only until the hand releases the bottle.)

▪**What do freely falling objects experience?**

The force we feel as weight is the retarding force of a floor or chair to keep us from falling. A free-falling object does not have such a retarding force, so it feels 'weightless'.

Try it yourself!

Instructions: (It is best to try this outdoors)

1. Have an adult, with a knife or awl, poke a small circular hole in the side of the bottle, near the bottom.
2. Cover the hole with your thumb and fill the bottle with water.
3. Uncover the hole and the water streams out (with the cap off).
4. Before the water runs out, drop the bottle. Watch whether the water comes out faster, slower, or the same.
5. Refill the bottle, uncover the hole, and toss the bottle straight upward or upward at an angle (while keeping the bottle upright). Again watch the water stream.